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Gear et al.

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(54) **HUMAN PRESENCE DETECTION**

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H04W 4/80 (2018.01)
(Continued)

(52) **U.S. Cl.**
CPC ***G08B 21/22*** (2013.01); ***G06F 1/3231*** (2013.01); ***H04W 4/80*** (2018.02); ***H04W 76/14*** (2018.02); *Y02D 10/173* (2018.01)

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CPC combination set(s) only.
See application file for complete search history.

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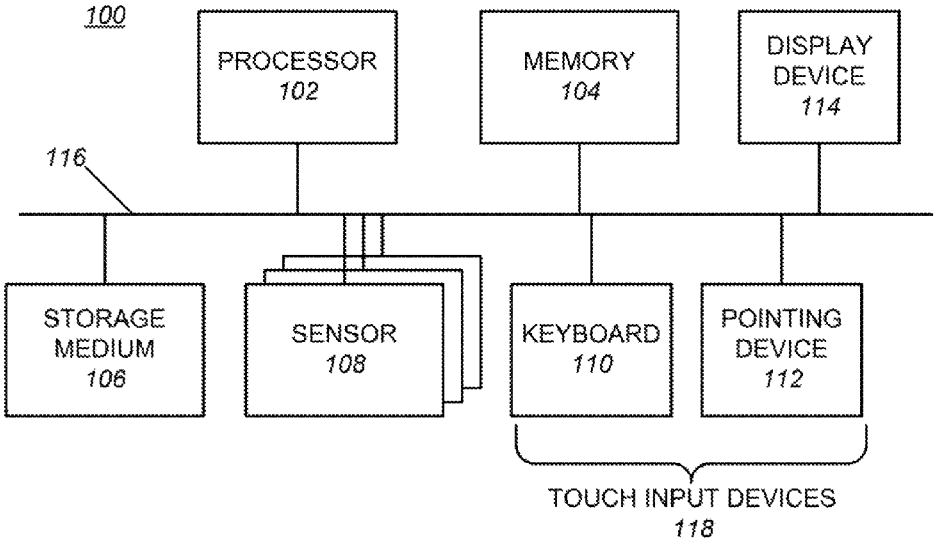
(57) **ABSTRACT**

Methods and a computing device are disclosed. A computing device may aggregate a number of inputs indicative of a presence or an absence of a human being within a proximity of the computing device. A source of at least one of the inputs may be a human presence sensor. A source of other inputs may provide an indication of the presence of a human being with corresponding estimated probabilities or corresponding estimated reliabilities which may provide an estimate of an accuracy of respective indications. In some embodiments, if any of the number of inputs indicate the presence of a human being, the computing device may determine that a human being is present. In other embodiments, if a corresponding estimated probability or reliability of an input is less than a predetermined value, then the input may be discarded when determining whether a human being is present.

20 Claims, 9 Drawing Sheets



Related U.S. Application Data

continuation of application No. 14/958,772, filed on Dec. 3, 2015, now Pat. No. 9,652,967, which is a continuation of application No. 12/968,246, filed on Dec. 14, 2010, now Pat. No. 9,268,390.

(51) **Int. Cl.**

G06F 1/3231	(2019.01)
H04W 76/14	(2018.01)

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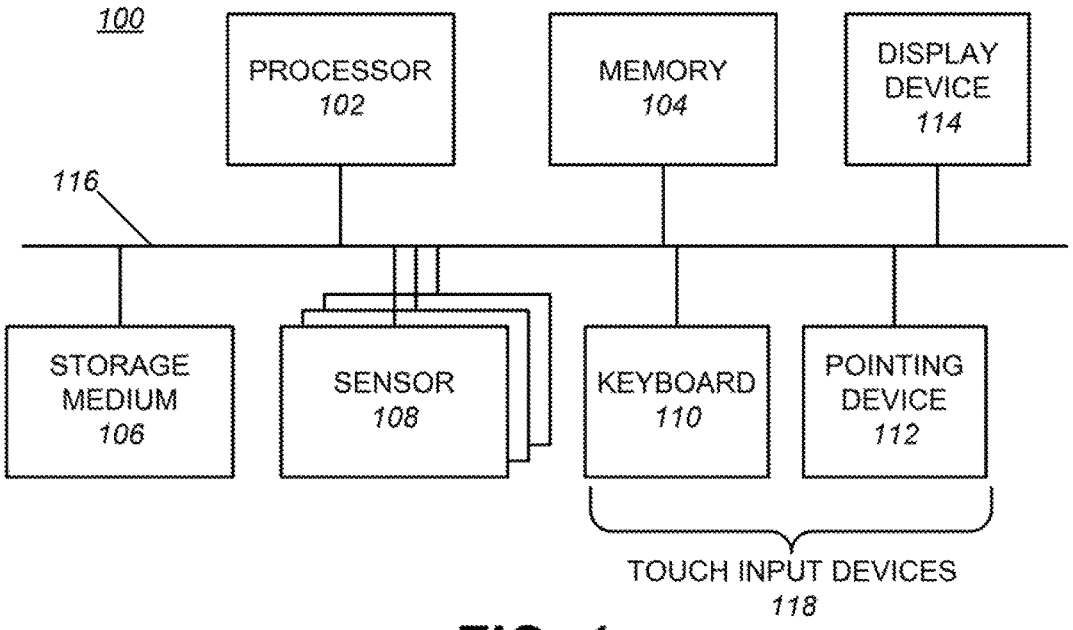

100
PROCESSOR
102
MEMORY
104
DISPLAY
DEVICE
114
116
STORAGE
MEDIUM
106
SENSOR
108
KEYBOARD
110
POINTING
DEVICE
112
TOUCH INPUT DEVICES
118

FIG. 1

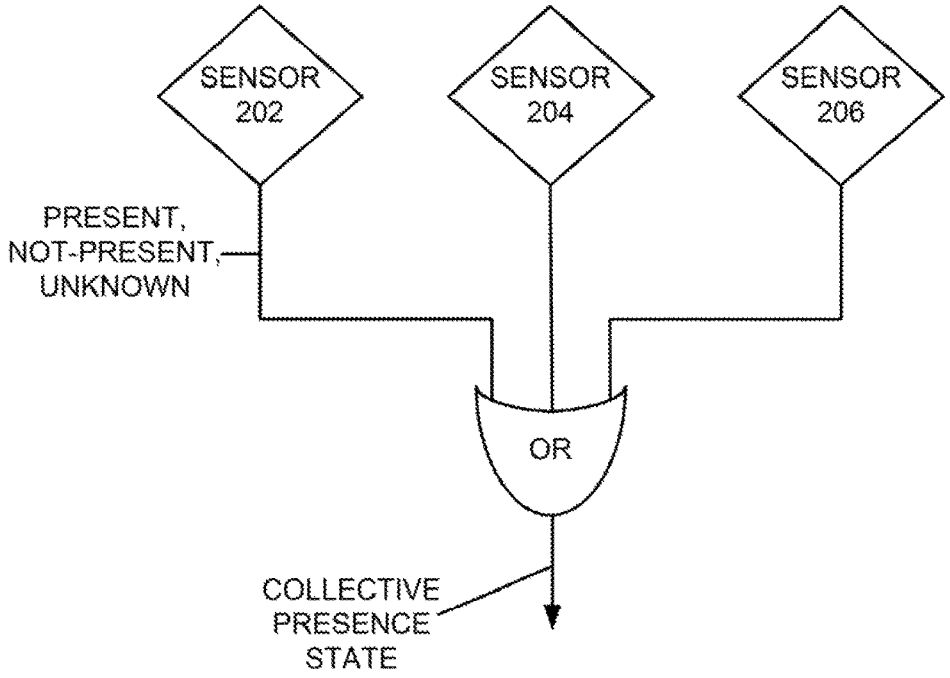

SENSOR
202
SENSOR
204
SENSOR
206
PRESENT,
NOT-PRESENT,
UNKNOWN
OR
COLLECTIVE
PRESENCE
STATE

FIG. 2

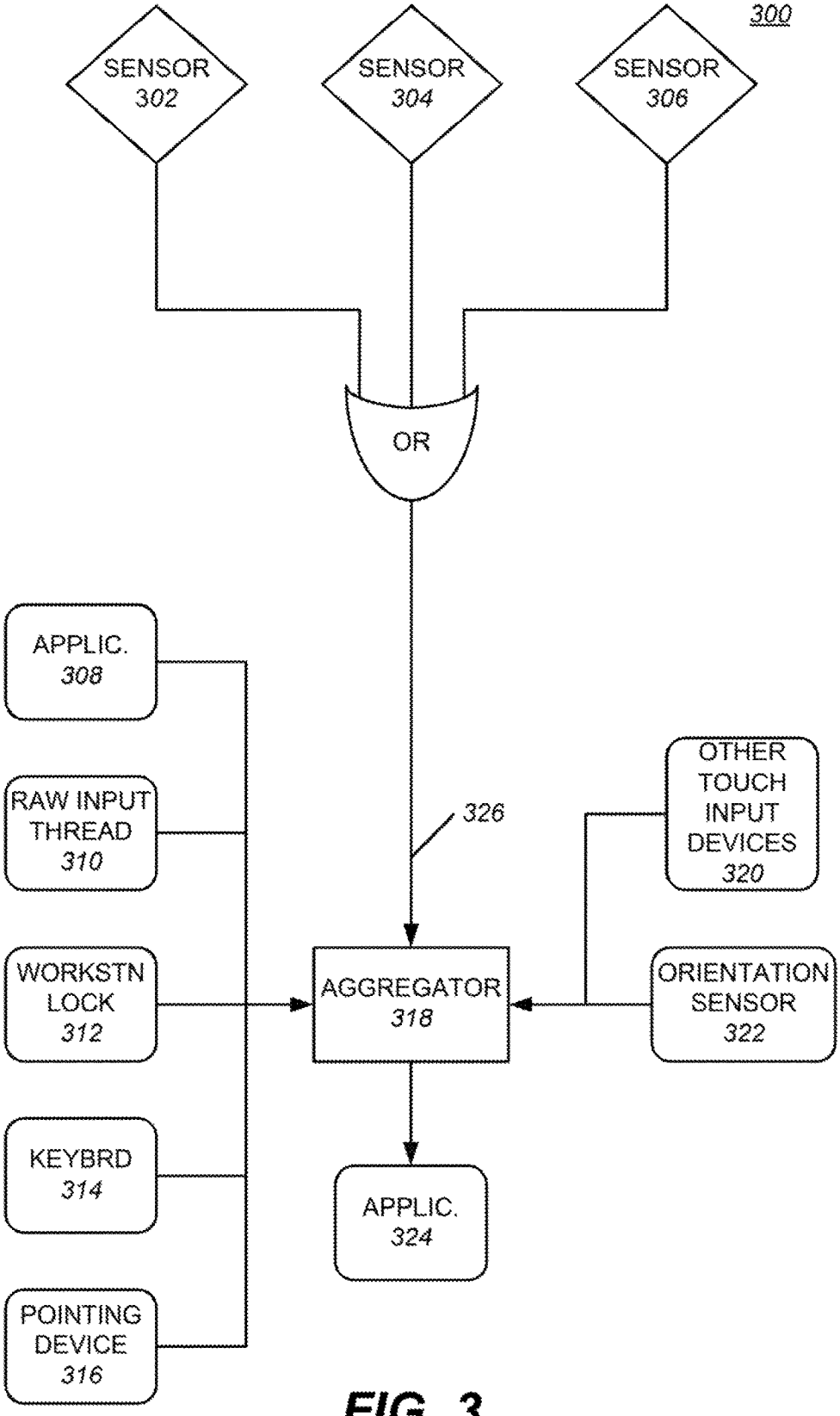

300
SENSOR 302
SENSOR 304
SENSOR 306
OR
326
APPLIC. 308
RAW INPUT THREAD 310
WORKSTN LOCK 312
KEYBRD 314
POINTING DEVICE 316
AGGREGATOR 318
OTHER TOUCH INPUT DEVICES 320
ORIENTATION SENSOR 322
APPLIC. 324

FIG. 3

FIG. 4

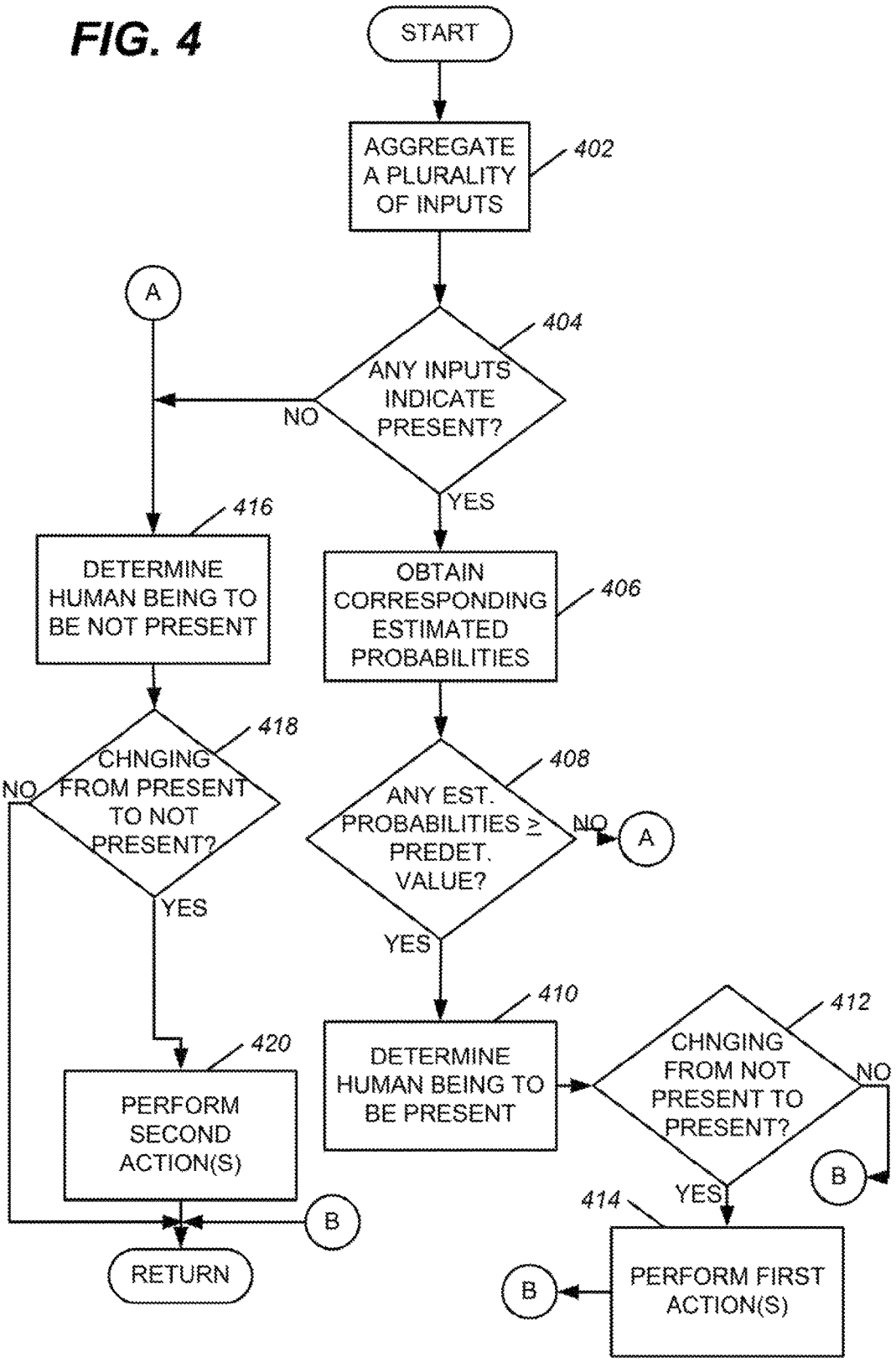
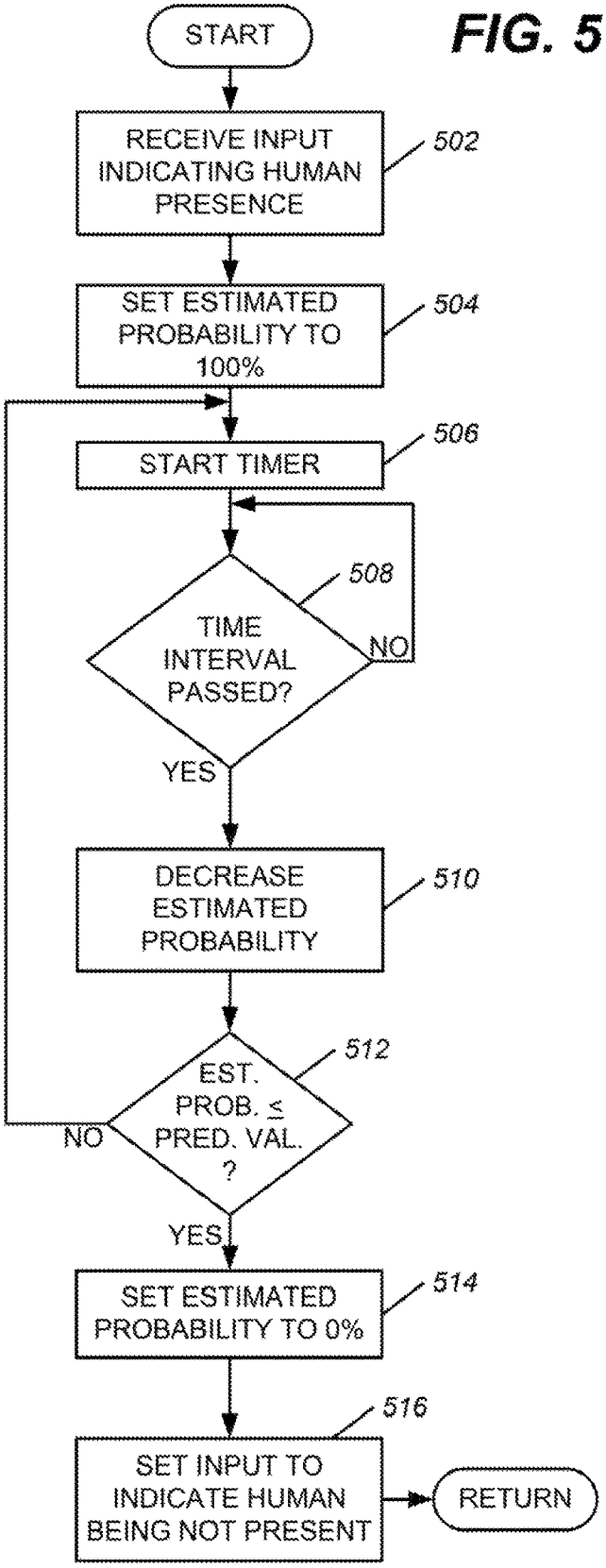

START
AGGREGATE A PLURALITY OF INPUTS
402
ANY INPUTS INDICATE PRESENT?
404
NO
YES
A
DETERMINE HUMAN BEING TO BE NOT PRESENT
416
OBTAIN CORRESPONDING ESTIMATED PROBABILITIES
406
CHNGING FROM PRESENT TO NOT PRESENT?
418
NO
YES
ANY EST. PROBABILITIES ≥ PREDET. VALUE?
408
NO
A
YES
PERFORM SECOND ACTION(S)
420
DETERMINE HUMAN BEING TO BE PRESENT
410
CHNGING FROM NOT PRESENT TO PRESENT?
412
NO
B
YES
414
B
PERFORM FIRST ACTION(S)
B
RETURN

FIG. 5


START
RECEIVE INPUT INDICATING HUMAN PRESENCE
502
SET ESTIMATED PROBABILITY TO 100%
504
START TIMER
506
TIME INTERVAL PASSED?
508
NO
YES
DECREASE ESTIMATED PROBABILITY
510
EST. PROB. ≤ PRED. VAL. ?
512
NO
YES
SET ESTIMATED PROBABILITY TO 0%
514
SET INPUT TO INDICATE HUMAN BEING NOT PRESENT
516
RETURN

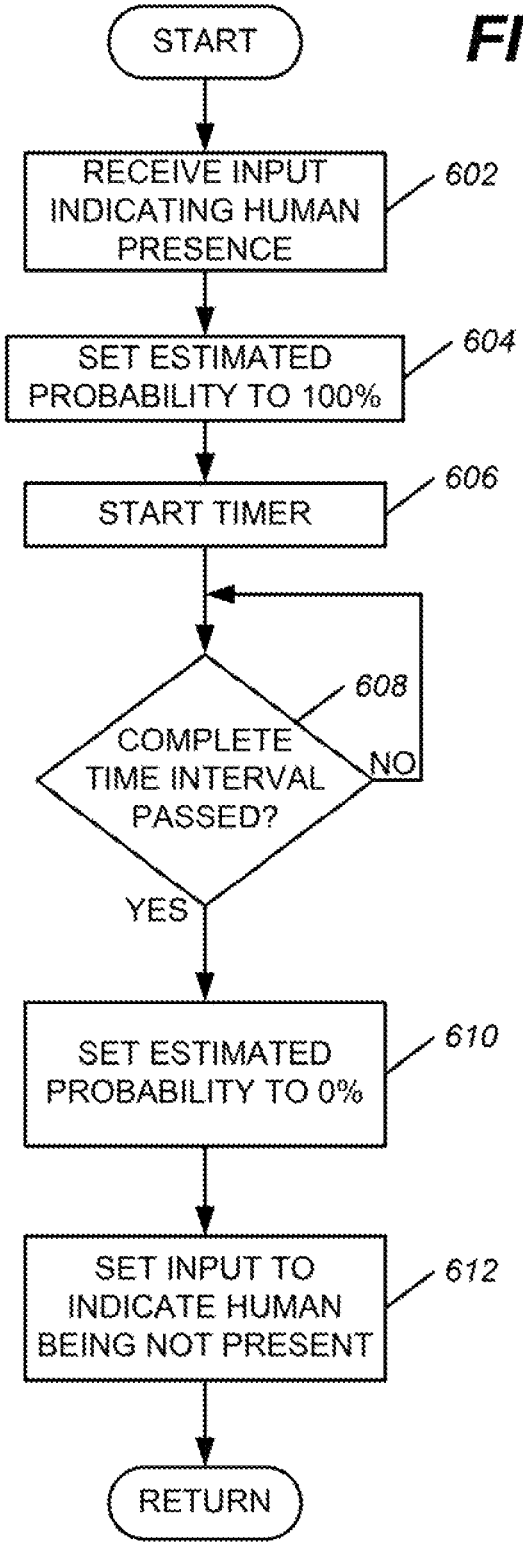

START
RECEIVE INPUT INDICATING HUMAN PRESENCE
602
SET ESTIMATED PROBABILITY TO 100%
604
START TIMER
606
COMPLETE TIME INTERVAL PASSED?
608
NO
YES
SET ESTIMATED PROBABILITY TO 0%
610
SET INPUT TO INDICATE HUMAN BEING NOT PRESENT
612
RETURN

FIG. 6

FIG. 7

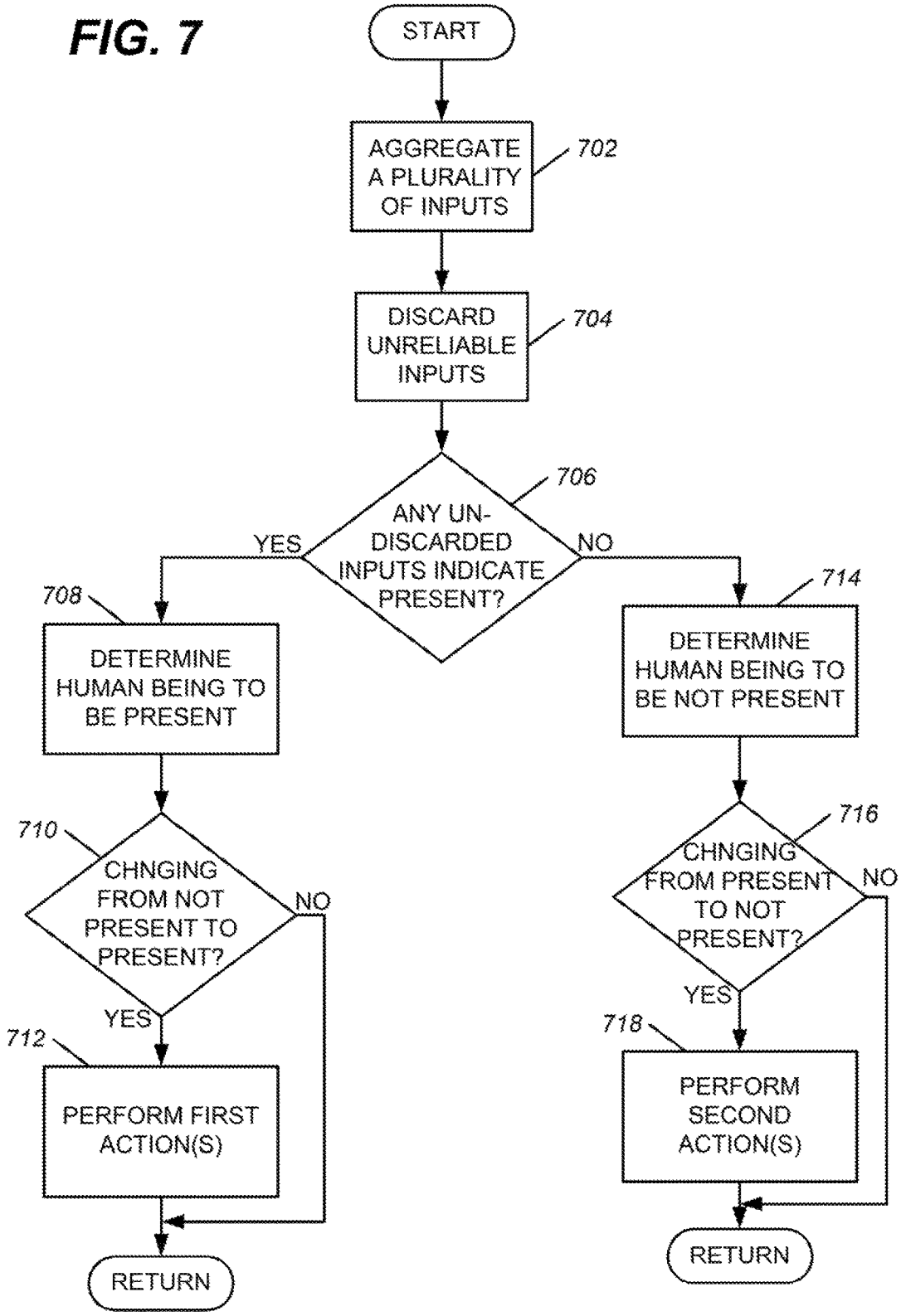

START
AGGREGATE A PLURALITY OF INPUTS
702
DISCARD UNRELIABLE INPUTS
704
ANY UN-DISCARDED INPUTS INDICATE PRESENT?
706
YES
NO
708
DETERMINE HUMAN BEING TO BE PRESENT
710
CHNGING FROM NOT PRESENT TO PRESENT?
NO
YES
712
PERFORM FIRST ACTION(S)
RETURN
714
DETERMINE HUMAN BEING TO BE NOT PRESENT
716
CHNGING FROM PRESENT TO NOT PRESENT?
NO
YES
718
PERFORM SECOND ACTION(S)
RETURN

FIG. 8

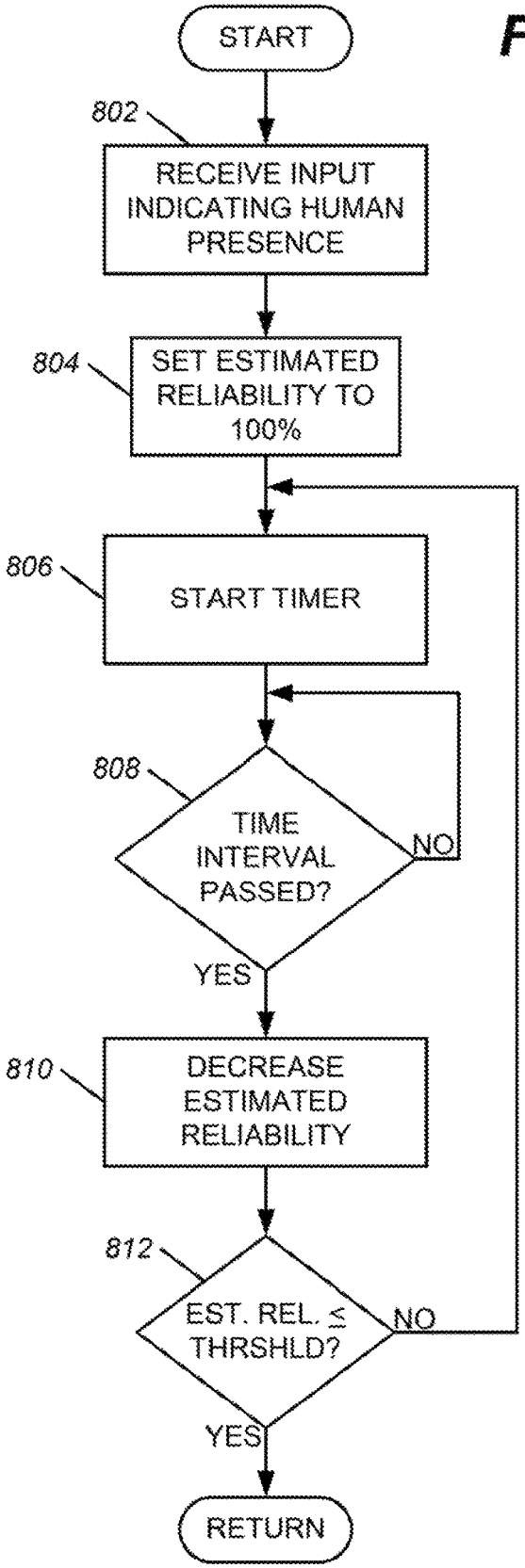

START
802
RECEIVE INPUT INDICATING HUMAN PRESENCE
804
SET ESTIMATED RELIABILITY TO 100%
806
START TIMER
808
TIME INTERVAL PASSED?
NO
YES
810
DECREASE ESTIMATED RELIABILITY
812
EST. REL. ≤ THRSHLD?
NO
YES
RETURN

FIG. 9

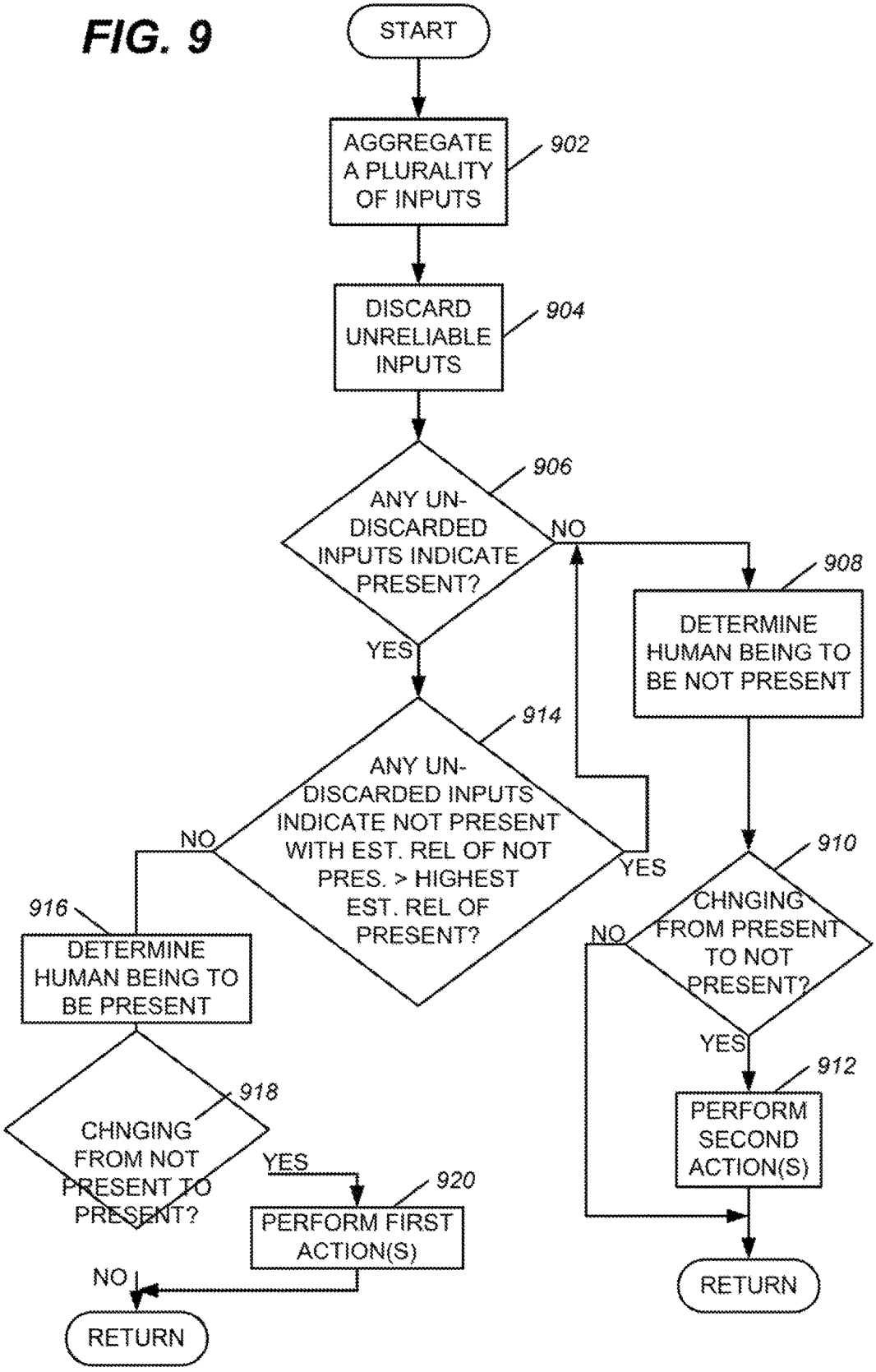
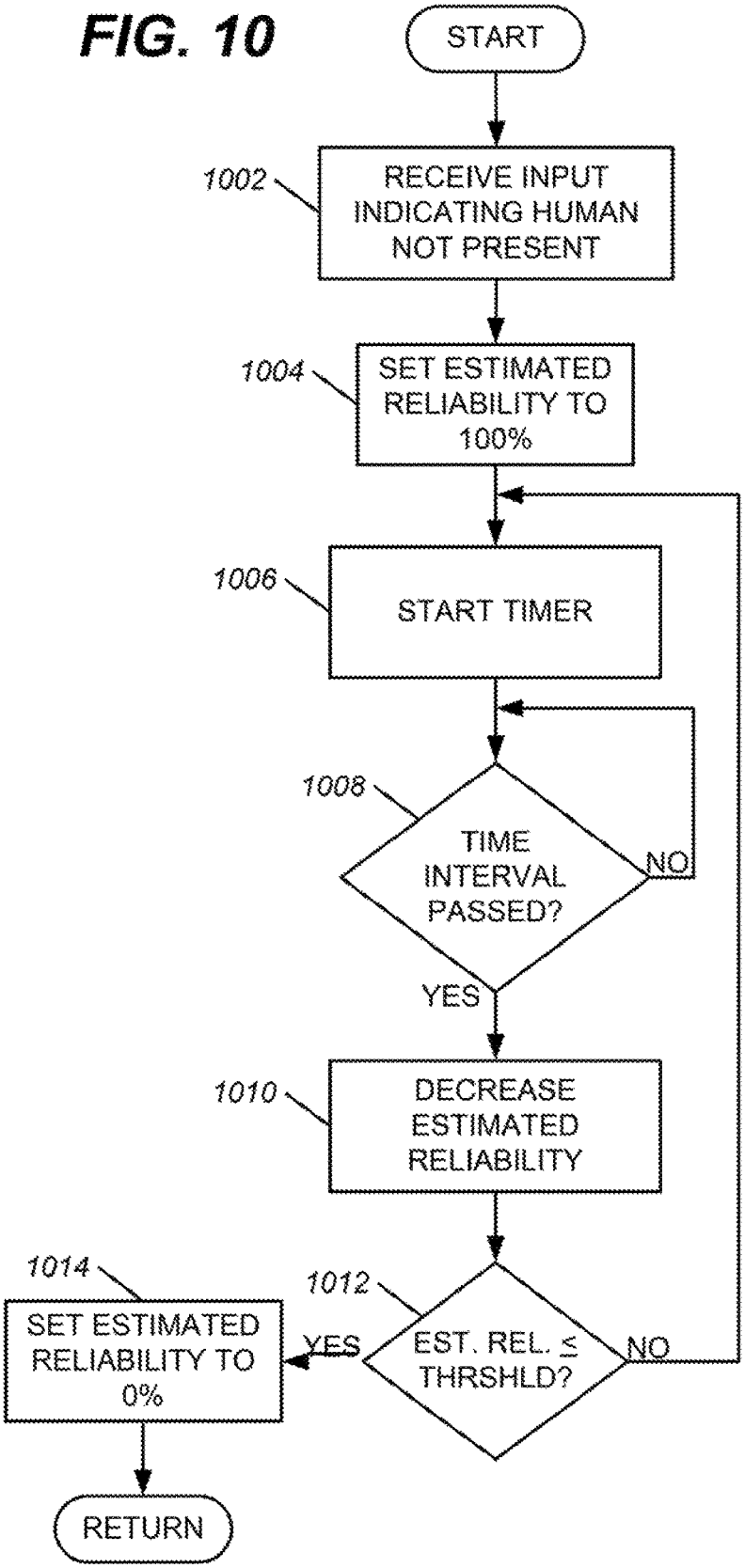

START
AGGREGATE A PLURALITY OF INPUTS
902
DISCARD UNRELIABLE INPUTS
904
ANY UN-DISCARDED INPUTS INDICATE PRESENT?
906
NO
YES
DETERMINE HUMAN BEING TO BE NOT PRESENT
908
ANY UN-DISCARDED INPUTS INDICATE NOT PRESENT WITH EST. REL OF NOT PRES. > HIGHEST EST. REL OF PRESENT?
914
NO
YES
DETERMINE HUMAN BEING TO BE PRESENT
916
CHNGING FROM PRESENT TO NOT PRESENT?
910
NO
YES
CHNGING FROM NOT PRESENT TO PRESENT?
918
YES
PERFORM FIRST ACTION(S)
920
PERFORM SECOND ACTION(S)
912
NO
RETURN
RETURN

FIG. 10


START
1002
RECEIVE INPUT INDICATING HUMAN NOT PRESENT
1004
SET ESTIMATED RELIABILITY TO 100%
1006
START TIMER
1008
TIME INTERVAL PASSED?
NO
YES
1010
DECREASE ESTIMATED RELIABILITY
1012
EST. REL. ≤ THRSHLD?
YES
NO
1014
SET ESTIMATED RELIABILITY TO 0%
RETURN

HUMAN PRESENCE DETECTION

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a Continuation Application of, and takes benefit of, application Ser. No. 15/481,398, filed on 6 Apr. 2017, entitled HUMAN PRESENCE DETECTION, which is a Continuation Application of, and takes benefit of, application Ser. No. 14/958,772, filed on 3 Dec. 2015 and issued as U.S. Pat. No. 9,652,967, entitled HUMAN PRESENCE DETECTION, which is a Continuation Application of, and takes benefit of, application Ser. No. 12/968,246, filed on 14 Dec. 2010 and issued as U.S. Pat. No. 9,268,390 entitled HUMAN PRESENCE DETECTION, all of which are hereby incorporated in their entirety by reference.

BACKGROUND

Operating systems in modern computing devices implement logic to manage power states of various components and to lock-down access to the computing device. One part of the implemented logic concerns the proximity of a user with respect to a computing device.

Many existing computing devices rely solely on detecting input from a keyboard, a pointing device, a touch screen, or other input device by which a presence of a human being may be inferred. Each time a computing device detects the input, a timer may be started. The timer may be set for a time period, such as, for example, 15 minutes, 30 minutes, or another time period. Upon expiration of the timer, the computing device determines that a human being is not present at the computing device. However, a human being may be present and using a computing device with long periods of input inactivity. For example, a user may perform activities including, but not limited to, reading content or watching a video without providing any input. In such situations, the computing device may wrongly determine that the user is not present. As a result, various features of the computing device, which depend on making a determination regarding whether a human being is present or not present within a given proximity of the computing device, may not provide a consistent user experience.

SUMMARY

This Summary is provided to introduce a selection of concepts in a simplified form that is further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

In an embodiment consistent with the subject matter of this disclosure, a number of inputs may be received by a computing device. At least some of the inputs may indicate a presence or absence of the human being within a given proximity of the computing device. A source of one or more of the inputs may be a human presence sensor, which detects the presence or the absence of a human being within the given proximity of the computing device. In some embodiments, the human presence sensor may include a hybrid ambient light sensor with reflective infrared proximity and presence detection.

An inference of a presence or an absence of a human being may be made with respect to one or more others of the inputs. A source of the one or more others of the inputs may include, but not be limited to, an orientation change sensor, a keyboard, a pointing device, a touch screen, an interactive application, or any other source indicative of a presence of the human being.

In some embodiments, if any of the inputs indicate that a human being is present within the proximity of the computing device, then the computing device may make a determination that the human being is present.

In other embodiments, each of the inputs that indicate that a human being is present within the proximity of the computing device may have a corresponding estimated probability or a corresponding estimated reliability. If any of the inputs that indicate that a human being is present have a corresponding estimated probability or a corresponding estimated reliability that is less than a given value, then those inputs may be discarded when determining whether a human being is present or absent within the proximity of the computing device.

In some embodiments, some inputs may have a corresponding estimated probability or a corresponding estimated reliability that deteriorates over a period of time.

DRAWINGS

In order to describe the manner in which the above-recited and other advantages and features can be obtained, a more particular description is discussed below and will be rendered by reference to specific embodiments thereof which are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments and are not therefore to be considered to be limiting of its scope, implementations will be described and explained with additional specificity and detail through the use of the accompanying drawings.

FIG. **1** is a block diagram of an exemplary computing device which may implement embodiments consistent with the subject matter of this disclosure.

FIG. **2** is a block diagram of a portion of an exemplary embodiment having three human presence sensors.

FIG. **3** is a block diagram of a portion of another exemplary embodiment having three human presence sensors, an orientation sensor, and other inputs indicative of a presence or an absence of a human being within a proximity of a computing device.

FIGS. **4-10** are flowcharts illustrating exemplary processing which may be performed by a computing device in various embodiments consistent with the subject matter of this disclosure.

DETAILED DESCRIPTION

Embodiments are discussed in detail below. While specific implementations are discussed, it should be understood that this is done for illustration purposes only. A person skilled in the relevant art will recognize that other components and configurations may be used without parting from the spirit and scope of the subject matter of this disclosure.

Overview

In various embodiments, a number of inputs may be received, which may indicate a presence or an absence of a human being within a given proximity of a computing device. At least one of the inputs is from a human presence sensor, which detects the presence or the absence of a human being within a given proximity of a computing device. In some embodiments, the human presence sensor may detect

a human being by using reflective infrared light to perform reflective infrared proximity and presence detection. That is, in some embodiments, the human presence sensor may detect a human being by analyzing reflected infrared light.

Other sensors may also be employed including, but not limited to, an orientation change sensor for detecting a change in orientation of the computing device or a component thereof, such as a change from a portrait orientation to a landscape orientation, or vice versa. Other inputs may be received from a keyboard, a pointing device (including, but not limited to, a computer mouse, a joy stick or a touch screen), an interactive application, or any other source of input indicative of a presence of a human being. In this patent application, a touch input device refers to any device that requires a human being to touch the device to provide input. Examples of a touch input device include, but are not limited to, a keyboard, a pointing device, and a touch screen.

In some implementations, if any of at least one human presence sensor indicates that a human being is present within a proximity of a computing device, then the computing device may determine that the human being is present. If, in addition to the at least one human presence sensor, one or more other inputs are provided that are indicative of a presence or an absence of the human being, then if any of the inputs indicate a presence of the human being, then the computing device may determine that the human being is present within the proximity of the computing device.

In some embodiments, each of the inputs may indicate a presence or an absence of a human being within a proximity of the computing device and a respective estimated probability of the presence or the absence of the human being. If any of the inputs indicate that the human being is present within the proximity of the computing device and the respective estimated probability of the presence of the human being is greater than or equal to a predetermined value, then the computing device may determine that the human being is present within the proximity of the computing device. Otherwise, the computing device may determine that the human being is not present.

If the computing device determines that the human being is present, the computing device may perform one or more first actions. If the computing device determines that the human being is not present, the computing device may perform one or more second actions.

In a variation of the embodiments, a respective estimated probability regarding one or more inputs indicating a presence of a human being may deteriorate over a given period of time.

In another variation of the embodiments, one or more inputs may indicate a presence or absence of a human being with a reliability which may deteriorate over a given period of time. The one or more inputs that have a reliability less than a threshold value may be discarded when determining whether the human being is present or absent.

Exemplary Computing Device

FIG. **1** is a block diagram of an exemplary computing device **100**, which may be employed to implement one or more embodiments consistent with the subject matter of this disclosure. Exemplary computing device **100** may be a personal computer (PC), a notebook computer, a handheld computing device, a server, or other type of computing device. Exemplary computing device **100** may include a processor **102**, a memory **104**, a storage medium **106**, one or more sensors **108**, a keyboard **110**, a pointing device **112**, a display device **114** and a communication bus **116** connecting processor **102** with memory **104**, storage medium **106**, one or more sensors **108**, keyboard **110**, pointing device **112** and display device **114**. Some embodiments of computing device **100** may further include a hardware logic component, including, but not limited to, an application specific integrated circuit (ASIC (not shown) and/or a field programmable gate array (FPGA) (not shown) that may be combined with instructions in memory **104** to cause computing device **100** to perform a method.

Processor **102** may include one or more conventional processors that interpret and execute instructions. Memory **104** may include a Random Access Memory (RAM), a Read Only Memory (ROM), and/or other type of dynamic or static storage medium that stores information and instructions for execution by processor **102**. The RAM, or the other type of dynamic storage medium, may store instructions as well as temporary variables or other intermediate information used during execution of instructions by processor **120**. The ROM, or the other type of static storage medium, may store static information and instructions for processor **102**.

Storage medium **106** may include any type of medium capable of storing information and/or instructions in a machine-readable form.

One or more sensors **108** may include, but not be limited to, a human presence sensor and an orientation sensor. The orientation sensor may include an accelerometer sensor which detects a change in orientation of computing device **100** or a component of computing device **100** including, but not limited to, a display device of computing device **100**. For example, the orientation sensor may sense a change in orientation from a portrait orientation to a landscape orientation or vice versa. The human presence sensor may include, but not be limited to, a hybrid ambient light sensor with reflective infrared proximity and presence detection, a capacitive proximity sensor, or a short-range wireless transceiver. An example of a short-range wireless transceiver may include, but not be limited to, a Bluetooth® transceiver (Bluetooth is a registered trademark of Bluetooth Sig., Inc. of Bellevue. Wash.). When using the short-range wireless transceiver as a human presence sensor, a human being may carry a short-range wireless transmitter such that the short-range wireless transceiver detects a signal transmitted from the short-range wireless transmitter when the human being is within a given proximity of computing device **100**.

Keyboard **110** may be a conventional keyboard or a soft keyboard displayed on a touch screen. Pointing device **112** may be any device by which a user may move a cursor on a display screen. Examples of pointing device **112** may include, but not be limited to, a computer mouse, a touchpad and a joystick. A touch input device **114** may include any device that a user touches in order to provide input to a computing device. Examples of touch input devices **114** may include, but not be limited to, keyboard **110**, pointing device **112**, and a touch screen (not shown).

Although FIG. **1** only shows three sensors **108**, other embodiments of a computing device may include one sensor **108**, two sensors **108**, or many sensors **108**, as well as other types of input devices.

Exemplary Embodiments

FIG. **2** illustrates an exemplary embodiment having three human presence sensors **202**, **204**, **206**. In the exemplary embodiment of FIG. **2**, at least one of human presence sensors **202**, **204**, **206** may be a hybrid ambient light sensor with reflective infrared proximity and presence detection. Each of sensors **202**, **204**, **206**, may be in a sensor state of

"Ready" or "Not Ready". If a sensor is in the "Ready" sensor state, then the sensor may provide a human presence indication of "Present" or "Not Present". If the sensor is in the "Not Ready" sensor state, then the sensor may provide a human presence indication of "Unknown". A sensor having a sensor state of "Not Ready" may not be used to determine whether a human being is present or not present. Rows of Table I illustrate possible sensor states and human presence indications with respect to human presence sensors, as discussed above.

TABLE 1

Sensor State	User Presence Indication
Ready	Present
Ready	Not Present
Not Ready	Unknown

In the embodiment of FIG. **2**, if any inputs from sensors **202**, **204**, **206** provide an indication of "Present", then an aggregated or collective presence state output may provide an indication of "Present".

FIG. **3** illustrates another exemplary embodiment **300**, which includes human presence sensors **302**, **304**, **306**, an aggregator **318**, inputs from an application **308**, a raw input thread **310**, a workstation lock **312**, a keyboard **314**, a pointing device **316**, other touch input device **320**, and an orientation sensor **322**.

A collective presence state **326** from human presence sensors **302**, **304**, **306** may be provided to aggregator **318**. If any one of human presence sensors **302**, **304**, **306** indicate that a human being is present, then collective presence state **326** may indicate that the human being is present.

Inputs from application **308**, raw input thread **310**, keyboard **314**, pointing device **316**, other touch input devices **320**, and an orientation sensor **322** may indicate a presence of a human being. If any one of collective presence state **326** and the inputs from application **308**, raw input thread **310**, workstation lock **312**, keyboard **314**, pointing device **316**, other touch input device **320**, or orientation sensor **322** indicate that a human being is present, then aggregator **318** may determine that a human being is present and may provide an input to an application **324** informing application **324** that the human being is present. Application **324** may cause one or more actions to be performed by a computing device upon being informed that the human being is present. In another embodiment, application **324** may cause one or more actions to be performed by the computing device upon being informed that the human being is not present.

In some embodiments, application **308** may be an interactive application. In other embodiments, application **308** may be another type of application including, but not limited to, a media player. Raw input thread **310** may include input from a user via any type of input device. Keyboard **314** may include, but not be limited to, a conventional keyboard or a soft keyboard displayed on a touch screen. Pointing device **316** may include, but not be limited to, a computer mouse, a touchpad, a joystick, or a finger or a stylus on a touch screen. Orientation sensor **322** may include an accelerometer for detecting a change in orientation, such as, for example, portrait to landscape, or landscape to portrait.

Each of the inputs to aggregator **318** may have a corresponding estimated probability or estimated reliability. For example, an estimated probability or an estimated reliability with respect to human presence sensors **302**, **304**, **306** indicating "Present" may be 100%. That is, in this embodiment, an estimated probability, or an estimated reliability with respect to any one of human presence sensors **302**, **304**, **306** correctly indicating that a human being is present may be 100%. However, an estimated probability, or an estimated reliability with respect to one or more other inputs indicating a presence of a human being may initially be 100%, but may deteriorate over a given time period, as will be explained in more detail later.

Workstation lock **312** may include, but not be limited to, a button, a switch, a soft button on a display, which when pressed or selected causes a computing device to be locked until, for example, a certain password is provided or another action is performed by a user. In some embodiments, workstation lock **312** may include a remote control signal or an application input, which, when received, causes a computing device to be locked until, for example, a certain password is provided or another action is performed by a user. When workstation lock **312** is activated to lock the computing device, workstation lock **312** may provide an input to aggregator **318** indicating that a human being is not present and an estimated probability or an estimated reliability with respect to the input from workstation lock **312** may initially be 100%, but may deteriorate over a period of time.

Although FIG. **3** illustrates an embodiment with three human presence sensors **302**, **304**, **306**, as well as other inputs, other embodiments may have a different number of human presence sensors or other types of inputs.

FIG. **4** is a flowchart illustrating exemplary processing for determining whether a human being is present within a proximity of a computing device in an embodiment consistent with the subject matter of disclosure. The process may be implemented by the computing device and may begin with the computing device aggregating a number of inputs which may indicate a presence or an absence of a human being within a given proximity of the computing device (act **402**). One or more of the inputs may be from a human presence sensor. Other inputs may be from a number of sources including, but not limited to, an application, a raw input thread, a keyboard, a pointing device, an orientation sensor, or any touch input device. In some embodiments, the human presence sensor may include a hybrid ambient light sensor with either reflective infrared proximity and presence detection or a capacitive proximity sensor for human presence detection.

The computing device may then determine whether any of the inputs indicate that a human being is present (act **404**). If any of the inputs indicate that a human being is present, then the computing device may obtain corresponding estimated probabilities with respect to any of the inputs that indicate a human being is present (act **406**). In this embodiment, when an input first indicates that a human being is present, a corresponding estimated probability with respect to the input may be 100% or another value. Some inputs, including, but not limited to, inputs from hybrid ambient light sensors with reflective infrared proximity presence detection, may always have a respective corresponding estimated probability of 100% when the inputs indicate that a human being is present. Other inputs, including, but not limited to, inputs from a keyboard, a pointing device, a raw input thread, an orientation sensor, or an interactive application, may initially have a respective corresponding estimated probability of 100% when the inputs first indicate that a human being is present. However, the estimated probability of the other inputs may deteriorate over a period of time.

The computing device may then determine whether any of the estimated probabilities, with respect to the inputs that indicate a human being is present, are greater than or equal

to a predetermined value, such as, for example, 75%, 80%, or another value (act **408**). If any of the estimated probabilities are greater than or equal to the predetermined value, then the computing device may determine that a human being is present (act **410**).

The computing device may then determine whether a transition is being made with respect to changing from a "Not Present" indication to a "Present" indication (act **412**). If the transition is not being made, then the procedure may be completed. Otherwise, the computing device may behave in a predetermined manner, including, but not limited to, performing one or more first actions (act **414**). In some embodiments, an indication that a human being is present may be provided to an application executing on the computing device. When the application receives the indication that a human being is present, the application may perform the one or more first actions. The one or more first actions may include, but not be limited to, locking a workstation, such that a user may not be permitted to enter any input until a particular user action is taken, such as, for example, entering a password or another particular user action.

If, during act **404**, no inputs are determined to indicate that a human being is present, or during act **408**, no estimated probabilities are greater than or equal to the predetermined value, then the process device may determine that a human being is not present (act **416**). The computing device may then determine whether a transition is being made with respect to changing from a "Present" indication to a "Not Present" indication (act **418**). If the transition is not being made, then the process may be complete. Otherwise, the computing device may behave in a second predetermined manner, including, but not limited to, performing one or more second actions (act **420**). In some embodiments, an indication that a human being is not present may be provided to a second application executing on the computing device. When the second application receives the indication that a human being is not present, the second application may perform the one or more second actions. In some embodiments, the one or more second actions may include, but not be limited to, prompting a user to perform an action for unlocking the computing device.

FIG. **5** is a flowchart illustrating an exemplary process for deteriorating, over a time period, an estimated probability with respect to one of the inputs, indicating that a human being is present. The process may begin with a computing device receiving an input indicating that a human being is present (act **502**). The computing device may set a corresponding estimated probability, with respect to a presence of a human being, to 100% (act **504**).

The computing device may then start a timer to time a predetermined timer interval (act **506**). The timer interval may be 30 seconds, 1 minute, or another timer interval. The computing device may then determine whether the timer interval has passed (i.e., the timer has expired) (act **508**). When the computing device determines that the timer has expired, the computing device may decrease the corresponding estimated probability by a predetermined amount, such as, for example, 5%, 10%, or another value (act **510**). The computing device may then determine whether the corresponding estimated probability is less than or equal to a predetermined value, such as, for example, 75%, 50%, or another predetermined value (act **512**). If the computing device determines that the estimated probability is not less than or equal to the predetermined value, then acts **506-512** may be performed again.

If, during act **512**, the computing device determines that the corresponding estimated probability is less than or equal to the predetermined value, then the computing device may set the estimated probability, with respect to the detecting a presence of a human being, to 0% (act **514**) and may set the indication associated with the input to indicate that a human being is not present (act **516**). The process may now be completed.

FIG. **6** illustrates exemplary processing with respect to a variation of the procedure illustrated by FIG. **5**. The process may begin with the computing device receiving an input indicating that a human being is present (act **602**). The computing device may then set a corresponding estimated probability, with respect to a presence of a human being, to 100% (act **604**). The computing device may then start a timer for a predetermined time interval, such as, for example, five minutes, 15 minutes, 30 minutes, or another predetermined time interval (act **606**).

During act **608**, the computing device may determine whether the timer has expired, indicating that the predetermined time interval has passed. If the computing device determines that the predetermined time interval has passed, the computing device may set the estimated probability, with respect to the presence of a human being, to 0% (act **610**). The computing device may then set the indication associated with the input to indicate that a human being is not present (act **612**). The process may now be completed.

FIG. **7** is a flowchart illustrating exemplary processing for determining whether a human being is present within proximity of a computing device in another embodiment consistent with the subject matter of this disclosure. The process may be implemented on the computing device and may begin with the computing device aggregating a number of inputs which may indicate a presence or an absence of a human being within a given proximity of the computing device (act **702**). One or more of the inputs may be from a human presence sensor. Other inputs may be from a number of sources including, but not limited to, an application, a raw input thread, a keyboard, a pointing device, an orientation sensor, or any touch input device. In some embodiments, the human presence sensor may include a hybrid ambient light sensor with reflective infrared proximity and presence detection or a capacitive proximity sensor for human presence detection.

The computing device may then discard unreliable inputs (act **704**). In this embodiment, each of the inputs may have a corresponding reliability value with respect to either a presence of a human being or an absence of a human being. An unreliable input may be an input with a reliability value that is less than a threshold value. The threshold value may be 50%, 60%, or some other threshold value.

After discarding the unreliable inputs, the computing device may then determine whether any of the un-discarded inputs indicate that a human being is present (act **706**). If at least one of the inputs indicate that a human being is present, then the computing device may determine that a human being is present (act **708**). The computing device may then determine whether a transition is occurring from an indication of "Not Present" to an indication of "Present" (act **710**). If the computing device determines that the transition is occurring, then the computing device may perform one or more first actions (act **712**). The one or more first actions may include, but not be limited to, backlighting a display screen, or powering on a storage medium device. The process may then be completed.

If, during act **706** the computing device determines that no un-discarded input indicates that a human being is present, then the computing device may determine that a human being is not present (act **714**). The computing device may

then determine whether a transition is occurring from an indication of "Present" to an indication of "Not Present" (act **716**). If the computing device determines that the transition from an indication of "Present" to an indication of "Not Present" is occurring, then the computing device may perform one or more second actions (act **718**). The one or more second actions may include, but not be limited to, locking the computing device such that no input may be entered, turning off a display device, or powering off a storage medium device. The process may then be completed.

In one embodiment, an application may perform the one or more first actions when an input is provided to an application indicating a transition from the "Not Present" indication to the "Present" indication. Similarly, the application or a second application may perform the one or more first actions when an input is provided to the application or the second application indicating a transition from the "Present" indication to the "Not Present" indication.

FIG. **8** is a flowchart illustrating exemplary processing performed by a computing device in an embodiment consistent with the subject matter of this disclosure. The exemplary processing decreases an estimated reliability value with respect to an input that indicates that a human being is present. In this embodiment, only some of the inputs may have their corresponding estimated reliability values decreased over time. Other inputs, including, but not limited to, at least some human presence sensors, may not have their corresponding estimated reliability values decreased over time.

The processing may begin with a computing device receiving an input indicating a that a human being is present (act **802**). In this exemplary process, the input is from a source which has decreasing reliability over time. In some embodiments, the source of the input having a decreasing reliability may include, but not be limited to, a raw input thread, a touch input device, or an orientation sensor.

After receiving the input, the computing device may set an estimated reliability associated with the received input to 100% or another value (act **804**). The computing device may then start a timer for a predetermined timer interval (act **806**). The timer interval may be 10 seconds, 1 minute, or another timer interval. The computing device may then determine whether the timer interval has passed (i.e., the timer expired) (act **808**).

If the timer interval has passed, then the computing device may decrease the estimated reliability associated with the received input by a given amount (act **810**). The given amount may be 5%, 10%, 15%, or some other value. The computing device may then determine whether the estimated reliability associated with the received input is less than or equal to a threshold value (act **812**). The threshold value is a value, such that when the estimated reliability is less than or equal to the threshold value, the associated input may be considered to be unreliable. In some embodiments, the threshold value may be configurable.

If the computing device determines that the estimated reliability is less than or equal to the threshold value, then the process is completed. Otherwise, acts **806-812** may again be performed to start the timer and decrease the estimated reliability by the given amount upon expiration of the timer.

FIG. **9** is a flowchart that illustrates exemplary processing of aggregated inputs in another embodiment consistent with the subject matter of this disclosure. The process may begin with a computing device aggregating a number of inputs which may indicate a presence or an absence of a human being within a given proximity of the computing device (act **902**). One or more of the inputs may be from a human presence sensor. Other inputs may be from a number of sources including, but not limited to, an application, a raw input thread, a keyboard, a pointing device, an orientation sensor, or any touch input device. In some embodiments, the human presence sensor may include a hybrid ambient light sensor with reflective infrared proximity and presence detection.

The computing device may discard unreliable inputs (act **904**). In this embodiment, each of the inputs that indicate that a human being is either present or not present may have a corresponding reliability value as indicated by a respective input. An unreliable input may be an input with a reliability value that is less than a threshold value. The threshold value may be 50%, 60%, or some other threshold value.

After discarding the unreliable inputs, the computing device may then determine whether any of the un-discarded inputs indicate that a human being is present (act **906**). If, during act **906**, the computing device determines that none of the un-discarded inputs indicate that a human being is present, then the computing device may determine that a human being is not present (act **908**). The computing device may then determine whether a transition is being made from detecting that a human being is present to the detecting that a human being is not present (act **910**). If the computing device determines that the transition is being made, then the computing device may perform one or more second actions (act **912**). As mentioned earlier, a "Not Present" indication may be provided to a second application, which may then perform the one or more second actions (act **912**). The process may then be completed.

If, during act **906**, the computing device determines that at least one of the inputs indicate that a human being is present, then the computing device may determine whether any un-discarded inputs that indicate a human being is not present have a higher estimated reliability then one of the inputs that indicate that a human being is present with an estimated reliability greater than or equal to any estimated reliability of any other of the inputs indicating that a human being is present (act **914**). If so, then act **908-912** may be performed by the computing device.

If, during act **914**, the computing device determines that none of the un-discarded inputs that indicate a human being is not present have an estimated reliability greater than the highest estimated reliability with respect to any of the inputs that indicate that a human being is present, then the computing device may determine that a human being is present (act **916**). The computing device may then determine whether a transition is being made from determining that a human being is not present to determining that a human being is present (act **918**). If, the computing device determines that the transition is being made from determining that a human being is not present to determining that a human being is present, then the computing device may perform one or more first actions (act **920**). As mentioned earlier, a "Present" indication may be provided to an application, which may then perform the one or more first actions. The process may now be completed.

FIG. **10** is a flowchart illustrating an exemplary process which may be performed by a computing device in some embodiments. The process may begin with receiving an input indicating that a human being is not present (act **1002**). In some embodiments, some of the inputs may indicate that a human being is not present. One example includes, but is not limited to, an input indicating that the computing device or workstation is locked by a user. After receiving the input, the computing device may set a corresponding estimated

reliability of the input to 100% or another value (act **1004**), thus indicating that a completely reliable input is received indicating that a human being is present within a proximity of the computing device.

The computing device may then start a timer to time a timer interval (act **1006**). The timer interval may be 10 seconds, 30 seconds, one minute, two minutes, or another value. The computing device may then determine whether the timer interval has passed (i.e., the timer expired) (act **1008**). If the timer interval expired, then the computing device may decrease the corresponding estimated reliability of the input by a given amount, such as, for example, 1%, 5%, 10%, or another given amount (act **1010**).

The computing device may then determine whether the corresponding estimated reliability of the input is less than or equal to a threshold value (act **1012**). The threshold value may be 50%, 55%, or another value. If the corresponding estimated reliability is determined to be less than or equal to the threshold value, then the corresponding estimated reliability may be set to 0 (act **1014**) and the process may be completed. Otherwise, the computing device may repeat acts **1006-1012**.

Conclusion

Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms for implementing the claims.

Other configurations of the described embodiments are part of the scope of this disclosure. For example, in other embodiments, an order of acts performed by a process may be different and/or may include additional or other acts. In some embodiments, one or more of the inputs may have a higher priority than others of the inputs, such that an input having the higher priority may cause a lower priority input to be discarded. In some other embodiments, a user may be permitted to configure one or more of the inputs to be discarded when determining whether a human being is or is not present. Such a feature may be useful when the user wishes to discard an input from a source that is defective and falsely indicates that a human being is present or not present.

Accordingly, the appended claims and their legal equivalents define embodiments, rather than any specific examples given.

What is claimed is:

1. A computing device comprising:

at least one processor; and

a memory coupled to the at least one processor, the memory including code that is executable by the at least one processor to cause the computing device to:

aggregate a plurality of inputs, at least one first input of the plurality of inputs being associated with a human presence sensor comprising a short-range wireless transceiver in possession of a human being, and at least one second input of the plurality of inputs being associated with a touch input device for detecting a presence or an absence of the human being within proximity of the computing device by detecting one or more human touches;

obtain one or more estimated probabilities of the presence of the human being from the plurality of inputs;

determine that the human being is present based on the one or more estimated probabilities; and

cause the computing device to perform a first one or more actions when the human being is determined to be present.

2. The computing device of claim **1**, wherein the short-range wireless transceiver comprises a Bluetooth-enabled device.

3. The computing device of claim **1**, wherein the touch input device comprises a device that detects a user input in response to an individual physically touching the touch input device.

4. The computing device of claim **1**, wherein the code is further executable to cause the computing device to:

determine the human being is present when any of the obtained estimated probabilities is greater than a predetermined value.

5. The computing device of claim **4**, wherein the corresponding estimated probability of the presence of the human being, with respect to the at least one second input of the plurality of inputs, deteriorates over time after the at least one second input of the plurality of inputs indicates the presence of the human being within the proximity of the computing device.

6. The computing device of claim **1**, wherein the human presence sensor comprises an ambient light sensor.

7. The computing device of claim **1** wherein the human presence sensor comprises an orientation sensor.

8. The computing device of claim **1**, wherein the human presence sensor provides the at least one second input to indicate one from a group consisting of present, not present, and unknown.

9. The computing device of claim **1**, wherein the at least one second input of the plurality of inputs comprises an input from the touch input device and an input from at least one other human presence sensor.

10. A machine-implemented method of detecting a presence or an absence of a human within proximity to a computing device, the machine-implemented method comprising:

aggregating a plurality of inputs, at least one first input of the plurality of inputs being associated with a human presence sensor comprising a short-range wireless transceiver in possession of a human being, and at least one second input of the plurality of inputs being associated with a touch input device for detecting a presence or an absence of the human being within proximity of the computing device by detecting one or more human touches;

obtaining one or more estimated probabilities of the presence of the human being from the plurality of inputs;

determining that the human being is present based on the one or more estimated probabilities; and

causing the computing device to behave in a predetermined manner when the determining determines that the human being is present, wherein

the machine-implemented method is performed by the computing device.

11. The method of claim **10**, wherein said short-range wireless transceiver is a Bluetooth-enabled device.

12. The method of claim **10**, wherein the touch input device comprises a device that detects a user input in response to an individual physically touching the touch input device.

13. The method of claim **10**, wherein the determining the human being is present comprises determining that the human being is present when any of the obtained estimated probabilities is greater than a predetermined value.

14. The method of claim 13, wherein the corresponding estimated probability of the presence of the human being, with respect to the at least one second input of the plurality of inputs, deteriorates over time after the at least one second input of the plurality of inputs indicates presence of the human being within the proximity of the computing device.

15. A machine-implemented method of detecting a presence or an absence of a human being, the machine-implemented method comprising:

aggregating a plurality of inputs, at least one first input of the plurality of inputs being associated with a human presence sensor comprising a short-range wireless transceiver in possession of a human being, and at least one second input of the plurality of inputs being associated with a touch input device for detecting a presence or an absence of the human being within proximity of a computing device by detecting one or more human touches;

obtaining one or more estimated probabilities of the presence of the human being from the plurality of inputs;

determining that the human being is absent based on the one or more estimated probabilities; and

causing the computing device to behave in a predetermined manner when the determining determines that the human being is absent, wherein

the machine-implemented method is performed by the computing device.

16. The method of claim 15, wherein said short-range wireless transceiver is a Bluetooth-enabled device.

17. The method of claim 15, wherein the touch input device comprises a device that detects a user input in response to an individual physically touching the touch input device.

18. The method of claim 15,

wherein the determining the human being is absent comprises determining that the human being is absent when the at least one of the obtained estimated probabilities is less than a predetermined value.

19. The method of claim 15, wherein the human presence sensor comprises a work station lock.

20. The method of claim 15, wherein the method further comprises:

obtaining corresponding estimated probabilities of the presence of the human being from each of the plurality of inputs, wherein the corresponding estimated probability of the presence of the human being, with respect to the at least one second input of the plurality of inputs, deteriorates over time after the at least one second input of the plurality of inputs indicates the presence of the human being within the proximity of the computing device; and

determining the human being is present based on at least one of the obtained estimated probabilities being greater than a predetermined value; wherein the determining the human being is absent comprises determining that the human being is absent when the at least one of the obtained estimated probabilities is less than a predetermined value.

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